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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/828,959

Applicant(s)

CHITTIBABU ET AL.

Examiner

Alan Diamond

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12 May 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-26 and 60-76 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-26 and 60-76 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 21 April 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Comments

1. The objection to claims 5 and 9 for informalities has been overcome by Applicant's amendment of the claims.
2. The Examiner notes that claims 27-59 have been cancelled. Thus, the objections and rejections of these claims are now moot.
3. The 102 and 103 rejections over claim 1 and its dependent claims using Maruyama et al, Nakamura, and Cao et al as primary references has been overcome by Applicant's amendment of claim 1 so as to require linking of the semiconductor particles with a first material different from the semiconductor material and comprising a metal. In each of Maruyama et al, Nakamura, and Cao et al, the semiconductor particles are linked by firing the particles. Thus, linking the semiconductor particles is the same material as the semiconductor particles.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.
5. Claims 1-24, 26, and 60-76 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

In claim 1, at line 3, generic "linking" of semiconductor particles with a first material different from the semiconductor particles and comprising a metal is not supported by the specification, as originally filed. The same applies to dependent claims 2-24 and 60.

In claim 26, at lines 5-6, titanium oxide film comprising particles generically "linked" by a first material is not supported by the specification, as originally filed. The same applies to dependent claim 61.

In claim 62, at line 3, semiconductor particles generically "linked" by a first material different from the particles and comprising a metal is not supported by the specification, as originally filed. The same applies to dependent claims 63-70.

In claim 71, at line 3, generic "linking" of the semiconductor particles with a first material comprising a metal is not supported by the specification, as originally filed. The same applies to dependent claims 72-76.

With respect to the above 35 USC 112, first paragraph, rejections of independent claims 1, 62, and 71, and their dependent claims, it is noted that the specification, as originally filed does support "cross-linking" and "cross-linked" (see, for example, page 2, lines 23-25). However, the more limited "cross-linking" and "cross-linked" is not sufficient support for the generic terms "linking" and "linked".

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

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(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claims 1-25 and 60 are rejected under 35 U.S.C. 102(a or b) as being anticipated by Koyanagi et al, WO 01/03232. The instant rejection is under 102(b) because, as noted above in the instant Office action, claims 1-25 and 60 are not supported by the originally filed disclosure, and likewise are not supported by instant provisional application 60/298,858. Alternatively, the instant rejection is under 102(a) because Koyanagi et al has a 102(a) publication date of 01/11/2001, which is prior to, but not more than one year prior to the 06/15/2001 filing date of said provisional application.

With respect to claims 1 and 25 Koyanagi et al prepares a photoelectric cell by providing TiO₂ semiconductor particles, contacting them with titanium acetylacetonatoalkoxide so as to form shells on the particles, and then binding the core/shell particles together by contacting them with peroxotitanic acid solution (see pages 79-80; and production example 2 and Example 21 at pages 116-123). In another example, the particles do not have a shell but are still contacted with the peroxotitanic acid (see the other Example 21 at pages 112-113). The titanium acetylacetonatoalkoxide along with the peroxotitanic acid read on the instant linking agent, or the peroxotitanic acid itself reads on the instant linking agent. Furthermore, and alternatively, Koyanagi et al teaches core particles composed of Sn-doped indium oxide, indium oxide or Ti₂O₃ having a shell of titanium oxide (i.e., titanium dioxide) and further a binder of titanium oxide (i.e., titanium oxide) to bind, i.e., link the particles (see

col. 11, lines 1-59). Thus, there are Sn-doped indium oxide, indium oxide or Ti_2O_3 particles linked by titanium dioxide.

With respect to claims 2, 9, 10, 25, and 60, said titanium acetylacetonatoalkoxide is organometallic, it is a metal alkoxide, and it is a sol gel precursor. Furthermore, the peroxotitanic acid is also a sol gel precursor.

With respect to claims 3-8, the titanium acetylacetonatoalkoxide, along with the peroxotitanic acid will result in metal-oxygen bond, i.e., the same bond as in the TiO_2 .

With respect to claims 11 and 25, a dye is applied to the semiconductor particles (see the Example 21 at pages 122-123).

With respect to claims 12-18, 20-23, and 25, in said Example 21 at pages 122-123, the semiconductor particles are disposed on a first (glass) substrate, and the a second (glass) substrate is placed over the semiconductor particles so as to electrically connect said first and second substrates. In place of glass, the other Example 21 at pages 112-113, uses polyimide and polyethylene terephthalate substrates. With respect to instant claims 12-18, it does not make a difference which of the polyimide and polyethylene terephthalate substrates is considered a first or second substrate because Koyanagi et al's TiO_2 particles can be disposed on either of the substrates. Koyanagi et al's device can be flexible and thin (page 5), and a flexible device will result when said polyimide and polyethylene terephthalate are used as the substrates.

With respect to claim 19, after the particles have been contacted with the peroxotitanic acid or after have been contacted with the titanium acetylacetonatoalkoxide to form the shell and then the peroxotitanic acid, the first

substrate is then heated to 350°C in the Example 21 at pages 112-113, or to 300°C in the Example 21 at pages 122-123.

With respect to claims 24 and 25, a "polymeric electrolyte" or "polyelectrolyte" can be incorporated in the cell since the electrolyte added to the cell can be one which contains a polymer-dispersed liquid crystal (see page 36).

Since Koyanagi et al teaches the limitations of the instant claims, the reference is deemed to be anticipatory.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claims 26 and 71-76 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakamura, U.S. Patent 6,291,763, in view of Hoffmann et al, U.S. Patent 5,830,597.

With respect to claims 26, 71, 75, and 76, Nakamura prepares a photovoltaic cell by providing TiO₂ semiconductor particles on a substrate and firing (heating) the particles, and thus linking the particles (see col. 5, lines 1-35; col. 7, lines 42-57; and Examples 1 and 2). In other words, TiO₂ semiconductor particles read on both the instant semiconductor particles and the instant first material. Nakamura's substrates can be flexible and transparent, and made from polymers such as polyethylene terephthalate, polyethylene naphthalate, or polyether-imide (see col. 6, lines 4-21; and

col. 14, lines 44-65). With respect to claims 26 and 73, a dye is applied to the semiconductor particles (see col. 7, line 66 through col. 8, line 29; and col. 33, line 66). With respect to claims 26 and 71, a polymeric electrolyte can be applied to the semiconductor particles (see col. 25, line 22 through col. 27, line 34). With respect to claims 26 and 74, Nakamura forms a Pt layer (6), which reads on the instant catalyst layer, on a second substrate that is the second electrode, and then joins the first and second substrates (see col. 34, lines 17-33; and Figure 1).

With respect to claim 72, the firing of the semiconductor particles can be at 100°C to 600°C (see col. 7, lines 42-47). Indeed, note Example 2 at col. 35 uses a temperature of 300°C. After the semiconductor particles have been fired (and thus, linked), the particles will begin to cool down, but will still be hot with a temperature less than the 300°C. Indeed, Nakamura teaches subsequent dye absorption to the linked semiconductor particles while the linked particles are still at 40°C to 80°C (see col. 13, lines 38-49). Furthermore, after the semiconductor particles have been linked, the heating will not be turned off exactly when all the particles are linked. There will most certainly be a period after the semiconductor particles are linked that the temperature is still maintained at 300°C before the heating is stopped.

Nakamura teaches the limitations of the instant claims other than the difference which is discussed below.

With respect to claims 26, 75, and 76, Nakamura does not specifically teach continuously forming its first and second electrodes and then continuously joining the first and second electrodes, i.e., Nakamura does not specifically teach a continuous

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process for preparing its photovoltaic cell. However, the use of continuous processing is well known in the art, as shown in Figure 2 of Hoffmann et al (see also col. 4, line 18 through col. 5, line 52). In Hoffmann et al's process, the TiO_2 (8), dye (9), and electrolyte layer (10) are disposed on a first substrate (5) in a continuous process (see said Figure 2; and col. 4, lines 30-62). The second substrate (6) can be provided with the electrically conductive layer (11) (see col. 4, lines 36-40). Hoffmann et al's method provides the advantage of producing a photovoltaic cell at low cost and with reproducibility (see col. 1, lines 18-20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared Nakamura's photovoltaic cell using continuous processing because such processing is conventional in the art, as shown by Hoffmann et al, and provides the advantage of producing a photovoltaic cell at low cost and with reproducibility, as taught by Hoffmann et al. While Hoffmann et al does not specifically teach the Pt catalyst layer in instant claim 26, this layer, as noted above, is taught by Nakamura. A skilled artisan clearly would have provided this Pt layer in addition to a conductive layer on Nakamura's second substrate.

10. Claims 1-26, 60-66, and 68-76 are rejected under 35 U.S.C. 103(a) as being unpatentable over Koyanagi et al, WO 01/03232, in view of Hoffmann et al, U.S. Patent 5,830,597.

With respect to claims 1 and 25, Koyanagi et al prepares a photoelectric cell by providing TiO_2 semiconductor particles, contacting them with titanium acetylacetonatoalkoxide so as to form shells on the particles, and then binding the core/shell particles together by contacting them with peroxotitanic acid solution (see

pages 79-80; and production example 2 and Example 21 at pages 116-123). In another Example, the particles do not have a shell but are still contacted with the peroxotitanic acid (see the other Example 21 at pages 112-113). The titanium acetylacetonatoalkoxide along with the peroxotitanic acid read on the instant linking agent, or the peroxotitanic acid itself reads on the instant linking agent. Furthermore, and alternatively, Koyanagi et al teaches core particles composed of Sn-doped indium oxide, indium oxide or Ti_2O_3 having a shell of titanium oxide (i.e., titanium dioxide) and further a binder of titanium oxide (i.e., titanium oxide) to bind, i.e., link the particles (see col. 11, lines 1-59). Thus, there are Sn-doped indium oxide, indium oxide or Ti_2O_3 particles linked by titanium dioxide.

With respect to claims 2, 9, 10, 25, 60, and 61, said titanium acetylacetonatoalkoxide is organometallic, it is a metal alkoxide, and it is a sol gel precursor. Furthermore, the peroxotitanic acid is also a sol gel precursor.

With respect to claims 3-8, the titanium acetylacetonatoalkoxide, along with the peroxotitanic acid will result in metal-oxygen bond, i.e., the same bond as in the TiO_2 .

With respect to claims 11, 70, and 73, dye is applied to the semiconductor particles (see the Example 21 at pages 122-123).

With respect to claims 12-18, 20-23, 25, 26, 62, 63, and 68, in said Example 21 at pages 122-123, the semiconductor particles are disposed on a first (glass) substrate, and the a second (glass) substrate is placed over the semiconductor particles so as to electrically connect said first and second substrates. In place of glass, the other Example 21 at pages 112-113, uses polyimide and polyethylene terephthalate

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substrates. With respect to instant claims 12-18, it does not make a difference which of the polyimide and polyethylene terephthalate substrates is considered a first or second substrate because Koyanagi et al's TiO_2 particles are disposed on either of the substrates. Koyanagi et al's device can be flexible and thin (page 5), and a flexible device will result when said polyimide and polyethylene terephthalate are used as the substrates.

With respect to claims 19, 64, 65, and 72, after the particles have been contacted with the peroxotitanic acid or after have been contacted with the titanium acetylacetonatoalkoxide to form the shell and then the peroxotitanic acid, the first substrate is then heated to 350°C in the Example 21 at pages 112-113, or to 300°C in the Example 21 at pages 122-123. With respect to claim 72, after the particles have been linked, the heating will not be turned off exactly when all the particles are cross-linked. There will most certainly be a period after the semiconductor particles are linked that the temperature is still maintained at 350°C or 300°C before the heating is stopped.

With respect to claims 24, 25, and 66, a "polymeric electrolyte" or "polyelectrolyte" can be incorporated in the cell since the electrolyte added to the cell can be one which contains a polymer-dispersed liquid crystal (see page 36).

With respect to claims 68 and 74, a Pt catalyst can be formed on the second substrate (see the Examples 21 at pages 112-113 and 122-123).

Koyanagi et al teaches the limitations of the instant claims other than the difference which is discussed below.

With respect to claims 26, 71, 75, and 76, Koyanagi et al does not specifically teach a continuous process for preparing its photovoltaic cell. However, the use of continuous processing is well known in the art, as shown in Figure 2 of Hoffmann et al (see also col. 4, line 18 through col. 5, line 52). In Hoffmann et al's process, the TiO_2 (8), dye (9), and electrolyte layer (10) are disposed on a first substrate (5) in a continuous process (see said Figure 2; and col. 4, lines 30-62). The second substrate (6) can be provided with the electrically conductive layer (11) (see col. 4, lines 36-40). Hoffmann et al's method provides the advantage of producing a photovoltaic cell at low cost and with reproducibility (see col. 1, lines 18-20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared Koyanagi et al's photovoltaic cell using continuous processing because such processing is conventional in the art, as shown by Hoffmann et al, and provides the advantage of producing a photovoltaic cell at low cost and with reproducibility, as taught by Hoffmann et al. While Hoffmann et al does not specifically teach the Pt catalyst layer in instant claim 26, this layer, as noted above, is taught by Koyanagi et al. A skilled artisan clearly would have provided this Pt layer in addition to a conductive layer on Koyanagi et al's second substrate.

11. Claim 67 is rejected under 35 U.S.C. 103(a) as being unpatentable over Koyanagi et al as applied to claims 1-26, 60-66, and 68-76 above, and further in view of Cao et al, "A Solid State Sensitized Photoelectrochemical Cell," J. Phys. Chem., vol. 99, pages 17071-17073, (1995).

Koyanagi et al, as relied upon for the reasons recited above, teaches the limitations of the instant claim 67, the difference being that Koyanagi et al does not specifically teach that its polymeric electrolyte can be as here claimed. Cao et al is relied upon for showing a photoelectrochemical cell employing a dye-sensitized, nanocrystalline TiO_2 electrode and a polymeric electrolyte (see page 17071). The electrolyte is prepared from 1.4 g of polyacrylonitrile (PAN), 10 g of ethylene carbonate, 5 mL of propylene carbonate, 5 mL of acetonitrile, 1.5 g of NaI, and 0.1 g of I_2 (see the Experimental section). The ethylene carbonate, propylene carbonate, and acetonitrile together read on the instant plasticizer. The NaI/ I_2 reads on the instant redox electrolyte. Since the densities of propylene carbonate and acetonitrile are 1.2 g/mL and 0.79 g/mL respectively, then there are 6 g of propylene carbonate and 3.95 g of acetonitrile. Thus, based on the total weight of polymer and plasticizer, there is 6.6% PAN and 93.4% plasticizer. The 1.5 g of NaI plus 0.1 g of I_2 in the 10 g ethylene carbonate, 5 mL propylene carbonate, and 5 mL acetonitrile is within the instant range of 0.5M to about 10M of redox electrolyte. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used Cao et al's polymeric electrolyte for the polymeric electrolyte in Koyanagi et al's photoelectric cell because Koyanagi et al specifically teaches that a polymeric electrolyte is to be used, and Cao et al's electrolyte is an example thereof.

Double Patenting

12. A rejection based on double patenting of the "same invention" type finds its support in the language of 35 U.S.C. 101 which states that "whoever invents or discovers any new and useful process ... may obtain a patent therefor ..." (Emphasis added). Thus, the term "same invention," in this context, means an invention drawn to

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identical subject matter. See *Miller v. Eagle Mfg. Co.*, 151 U.S. 186 (1894); *In re Ockert*, 245 F.2d 467, 114 USPQ 330 (CCPA 1957); and *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970).

A statutory type (35 U.S.C. 101) double patenting rejection can be overcome by canceling or amending the conflicting claims so they are no longer coextensive in scope. The filing of a terminal disclaimer cannot overcome a double patenting rejection based upon 35 U.S.C. 101.

13. Claim 25 is provisionally rejected under 35 U.S.C. 101 as claiming the same invention as that of claim 25 of copending Application No. 10/165,877. This is a provisional double patenting rejection since the conflicting claims have not in fact been patented.

14. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

15. Claims 1-24, 26, and 60-76 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-26 and 43-58 of copending Application No. 10/165,877. Although the conflicting claims are not identical, they are not patentably distinct from each other because, for example, the claims of said copending application do not specifically teach that the cross-linking agent is different from the semiconductor particles. However, it would have been

obvious to one of ordinary skill in the art at the time the invention was made to have used a cross-linking agent in the claims of said copending application that is different from the semiconductor because such is within the scope of the claims of said copending application.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

16. Claims 1-25 and 60 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-15 of copending Application No. 10/351,260 in view of Nakamura, U.S. Patent 6,291,763.

The claims of said copending application teach the instantly claimed methods, the difference being that the claims of said copending application do not specifically teach forming the semiconductor oxide nanoparticle layer as part of a photovoltaic device.

Nakamura prepares a photovoltaic cell by providing TiO_2 semiconductor particles on a substrate and firing (heating) the particles, and thus cross-linking the particles (see col. 5, lines 1-35; col. 7, lines 42-57; and Examples 1 and 2). In other words, TiO_2 semiconductor particles read on both the instant semiconductor particles and the instant cross-linking agent. The TiO_2 particles are thus, contacted with each other and then fired, as in instant claim 45.

With respect to claims 3-8, the interconnection of the particles is with the same material as the particles themselves, i.e., TiO_2 , and the TiO_2 contains a metal to non-metal bond, i.e., a bond of Ti metal to O non-metal.

With respect to claims 11, 50, and 54, a dye can be applied to the semiconductor particles (see col. 7, line 66 through col. 8, line 29; and col. 33, line 66).

With respect to claims 12-14, see Figure 1 and Example 1 of Nakamura which show the instant substrates.

With respect to claims 15-18, and 20-23, Nakamura's substrates can be flexible and transparent, and made from polymers such as polyethylene terephthalate, polyethylene naphthalate, or polyether-imide (which reads on the instant polyimide) (see col. 6, lines 4-21; and col. 14, lines 44-65).

With respect to claim 19 the firing of the semiconductor particles can be at 100°C to 600°C, the 100°C being anticipatory of the instant temperature (see col. 7, lines 42-47). Indeed, note Example 2 at col. 35 uses a temperature of 300°C.

With respect to claim 24, the photovoltaic cell further comprises a gelled electrolyte solution that includes the combination of I₂ and an iodide salt in a solvent, such as ethylene carbonate, propylene carbonate, etc, and a gelling agent such as polyacrylonitrile, polyvinylidene fluoride, etc (thus forming a polymeric polyelectrolyte has here claimed) (see col. 25, lines 21-65; and col. 26, lines 16-32).

The advantage of preparing a photovoltaic device is that electricity can be generated, and Nakamura's structure provides the advantage of excellent conversion efficiency (see col. 2, lines 24-26). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared a photovoltaic cell, such as one having the structure of Nakamura, using the semiconductor oxide nanoparticle layer in the claims of said copending application because the advantage of preparing a

photovoltaic device is that electricity can be generated, and Nakamura's structure provides the advantage of excellent conversion efficiency.

This is a provisional obviousness-type double patenting rejection.

17. Claims 26, 61-66 and 68-76 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-15 of copending Application No. 10/351,260 in view of Nakamura as applied to claims 1-25 and 60 above, and further in view of Hoffmann et al, U.S. Patent 5,830,597.

The claims of said copending application, in view of Nakamura, as relied upon the reasons recited above, teach the limitations of instant claims 26, 60-66 and 68-76, the difference being that Nakamura does not specifically teach a continuous process for preparing the photovoltaic cell. However, the use of continuous processing is well known in the art, as shown in Figure 2 of Hoffmann et al (see also col. 4, line 18 through col. 5, line 52). In Hoffmann et al's process, the TiO₂ (8), dye (9), and electrolyte layer (10) are disposed on a first substrate (5) in a continuous process (see said Figure 2; and col. 4, lines 30-62). The second substrate (6) can be provided with the electrically conductive layer (11) (see col. 4, lines 36-40). Hoffmann et al's method provides the advantage of producing a photovoltaic cell at low cost and with reproducibility (see col. 1, lines 18-20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared the photovoltaic cell of the claims of said copending application in view of Nakamura using continuous processing because such processing is conventional in the art, as shown by Hoffmann et al, and provides the advantage of producing a photovoltaic cell at low cost and with reproducibility, as taught

by Hoffmann et al. While Hoffmann et al does not specifically teach the Pt catalyst layer in instant claim 26, this layer, as noted above, is taught by Nakamura.

This is a provisional obviousness-type double patenting rejection.

18. Claim 67 is provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-15 of copending Application No. 10/351,260 in view of Nakamura and further in view of Hoffmann et al as applied to claims 1-26, 60-66 and 68-76 above, and further in view of Cao et al, "A Solid State Sensitized Photoelectrochemical Cell," J. Phys. Chem., vol. 99, pages 17071-17073, (1995).

The claims of said copending application, in view of Nakamura and further in view of Hoffmann et al, as relied upon for the reasons recited above, teach the limitations of claim 67, the difference being that neither the claims of said copending application, Nakamura, nor Hoffmann et al teaches the electrolyte composition in said claim 67. Nakamura teaches an electrolyte in its cell (see col. 25, line 18 through col. 27, line 36). Cao et al is relied upon for showing a photoelectrochemical cell employing a dye-sensitized, nanocrystalline TiO_2 electrode and an electrolyte (see page 17071). The electrolyte is prepared from 1.4 g of polyacrylonitrile (PAN), 10 g of ethylene carbonate, 5 mL of propylene carbonate, 5 mL of acetonitrile, 1.5 g of NaI, and 0.1 g of I_2 (see the Experimental section). The ethylene carbonate, propylene carbonate, and acetonitrile together read on the instant plasticizer. The NaI/ I_2 reads on the instant redox electrolyte. Since the densities of propylene carbonate and acetonitrile are 1.2 g/mL and 0.79 g/mL respectively, then there are 6 g of propylene carbonate and 3.95 g

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of acetonitrile. Thus, based on the total weight of polymer and plasticizer, there is 6.6% PAN and 93.4% plasticizer. The 1.5 g of NaI plus 0.1 g of I₂ in the 10 g ethylene carbonate, 5 mL propylene carbonate, and 5mL acetonitrile is within the instant range of 0.5M to about 10M of redox electrolyte. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used Cao et al's electrolyte in the claims of said copending application in view of Nakamura's photovoltaic cell because Nakamura specifically teaches that an electrolyte is be used, and Cao et al's electrolyte is an example thereof.

This is a provisional obviousness-type double patenting rejection.

19. Claims 1-25 and 60 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-19 of copending Application No. 10/918,493 in view of Nakamura, U.S. Patent 6,291,763.

The claims of said copending application teach the instantly claimed methods, the difference being that the claims of said copending application do not specifically teach forming the metal oxide interconnected nanoparticles as part of a photovoltaic device.

Nakamura prepares a photovoltaic cell by providing TiO₂ semiconductor particles on a substrate and firing (heating) the particles, and thus cross-linking the particles (see col. 5, lines 1-35; col. 7, lines 42-57; and Examples 1 and 2). In other words, TiO₂ semiconductor particles read on both the instant semiconductor particles and the instant cross-linking agent. The TiO₂ particles are thus, contacted with each other and then fired, as in instant claim 45.

With respect to claims 3-8, the interconnection of the particles is with the same material as the particles themselves, i.e., TiO_2 , and the TiO_2 contains a metal to non-metal bond, i.e., a bond of Ti metal to O non-metal.

With respect to claim 11, a dye can be applied to the semiconductor particles (see col. 7, line 66 through col. 8, line 29; and col. 33, line 66).

With respect to claims 12-14, see Figure 1 and Example 1 of Nakamura which show the instant substrates.

With respect to claims 15-18 and 20-23, Nakamura's substrates can be flexible and transparent, and made from polymers such as polyethylene terephthalate, polyethylene naphthalate, or polyether-imide (which reads on the instant polyimide) (see col. 6, lines 4-21; and col. 14, lines 44-65).

With respect to claim 19, the firing of the semiconductor particles can be at 100°C to 600°C , the 100°C being anticipatory of the instant temperature (see col. 7, lines 42-47). Indeed, note Example 2 at col. 35 uses a temperature of 300°C .

With respect to claim 24, the photovoltaic cell further comprises a gelled electrolyte solution that includes the combination of I_2 and an iodide salt in a solvent, such as ethylene carbonate, propylene carbonate, etc, and a gelling agent such as polyacrylonitrile, polyvinylidene fluoride, etc (thus forming a polymeric polyelectrolyte has here claimed) (see col. 25, lines 21-65; and col. 26, lines 16-32).

The advantage of preparing a photovoltaic device is that electricity can be generated, and Nakamura's structure provides the advantage of excellent conversion efficiency (see col. 2, lines 24-26). It would have been obvious to one of ordinary skill in

the art at the time the invention was made to have prepared a photovoltaic cell, such as one having the structure of Nakamura, using the metal oxide interconnected nanoparticles in the claims of said copending application because the advantage of preparing a photovoltaic device is that electricity can be generated, and Nakamura's structure provides the advantage of excellent conversion efficiency.

This is a provisional obviousness-type double patenting rejection.

20. Claims 26, 61-66 and 68-76 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-19 of copending Application No. 10/918,493 in view of Nakamura as applied to claims 1-25 and 60 above, and further in view of Hoffmann et al, U.S. Patent 5,830,597.

The claims of said copending application, in view of Nakamura, as relied upon the reasons recited above, teach the limitations of instant claims 26, 60-66 and 68-76, the difference being that Nakamura does not specifically teach a continuous process for preparing the photovoltaic cell. However, the use of continuous processing is well known in the art, as shown in Figure 2 of Hoffmann et al (see also col. 4, line 18 through col. 5, line 52). In Hoffmann et al's process, the TiO₂ (8), dye (9), and electrolyte layer (10) are disposed on a first substrate (5) in a continuous process (see said Figure 2; and col. 4, lines 30-62). The second substrate (6) can be provided with the electrically conductive layer (11) (see col. 4, lines 36-40). Hoffmann et al's method provides the advantage of producing a photovoltaic cell at low cost and with reproducibility (see col. 1, lines 18-20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared the photovoltaic cell of the claims of said

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compending application in view of Nakamura using continuous processing because such processing is conventional in the art, as shown by Hoffmann et al, and provides the advantage of producing a photovoltaic cell at low cost and with reproducibility, as taught by Hoffmann et al. While Hoffmann et al does not specifically teach the Pt catalyst layer in instant claim 26, this layer, as noted above, is taught by Nakamura.

This is a provisional obviousness-type double patenting rejection.

21. Claim 67 is provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-19 of compending Application No. 10/918,493 in view of Nakamura and further in view of Hoffmann et al as applied to claims 1-26, 60-66 and 68-76 above, and further in view of Cao et al, "A Solid State Sensitized Photoelectrochemical Cell," J. Phys. Chem., vol. 99, pages 17071-17073, (1995).

The claims of said compending application, in view of Nakamura and further in view of Hoffmann et al, as relied upon for the reasons recited above, teach the limitations of claim 67, the difference being that neither the claims of said compending application, Nakamura, nor Hoffmann et al teaches the electrolyte composition in said claim 67. Nakamura teaches an electrolyte in its cell (see col. 25, line 18 through col. 27, line 36). Cao et al is relied upon for showing a photoelectrochemical cell employing a dye-sensitized, nanocrystalline TiO_2 electrode and an electrolyte (see page 17071). The electrolyte is prepared from 1.4 g of polyacrylonitrile (PAN), 10 g of ethylene carbonate, 5 mL of propylene carbonate, 5 mL of acetonitrile, 1.5 g of NaI, and 0.1 g of I_2 (see the Experimental section). The ethylene carbonate, propylene carbonate, and

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acetonitrile together read on the instant plasticizer. The NaI/I₂ reads on the instant redox electrolyte. Since the densities of propylene carbonate and acetonitrile are 1.2 g/mL and 0.79 g/mL respectively, then there are 6 g of propylene carbonate and 3.95 g of acetonitrile. Thus, based on the total weight of polymer and plasticizer, there is 6.6% PAN and 93.4% plasticizer. The 1.5 g of NaI plus 0.1 g of I₂ in the 10 g ethylene carbonate, 5 mL propylene carbonate, and 5mL acetonitrile is within the instant range of 0.5M to about 10M of redox electrolyte. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used Cao et al's electrolyte in the claims of said copending application in view of Nakamura's photovoltaic cell because Nakamura specifically teaches that an electrolyte is be used, and Cao et al's electrolyte is an example thereof.

This is a provisional obviousness-type double patenting rejection.

Response to Arguments

22. Applicant's arguments filed May 12, 2005 have been fully considered but they are not persuasive.

Applicant argues that there is no indication that the peroxotitanic acid links the TiO₂ particles. Applicant argues that Koyanagi et al decomposes the acid, so that the particles are not cross-linked. However, it is the Examiner's position that the resulting material that is produced by the decomposition of the peroxotitanic acid does link the particles as here claimed, in the absence of a showing to the contrary. The Examiner maintains that the titanium acetylacetonatoalkoxide along with the peroxotitanic acid read on the instant linking agent, or the peroxotitanic acid itself reads on the instant

linking agent. Alternatively, Koyanagi et al teaches core particles composed of Sn-doped indium oxide, indium oxide or Ti_2O_3 having a shell of titanium oxide (i.e., titanium dioxide) and further a binder of titanium oxide (i.e., titanium dioxide) to bind, i.e., link the particles (see col. 11, lines 1-59). Thus, there are Sn-doped indium oxide, indium oxide or Ti_2O_3 particles linked by titanium dioxide.

Applicant argues that claims 60-76 are patentable. However, for the reasons set forth above in the instant Office action, it is the Examiner's position that they are not patentable.

Conclusion

23. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

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24. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Alan Diamond whose telephone number is 571-272-1338. The examiner can normally be reached on Monday through Friday, 5:30 a.m. to 2:00 p.m. ET.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Alan Diamond
August 2, 2005

Alan Diamond
Primary Examiner
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A handwritten signature in black ink, appearing to read 'Alan Diamond', with a stylized flourish at the end.